

CLAIMS

What is claimed is:

1. An integrated center frequency selectable resonant coupling network comprising in combination:
 - 5 an integrated coupling transformer having a secondary winding including a fixed capacitor parallel coupled thereto for coupling to a load and a primary winding for coupling to a source;
a first integrated capacitive circuit controllably coupled, by an integrated switch that is actively biased on and off, across a first one of said primary winding and said
10 secondary winding and when so coupled operable to resonate with said integrated coupling transformer at a first frequency in a first frequency band; and
a second integrated capacitive circuit controllably coupled across a second one of said primary winding and said secondary winding and when so coupled operable to
15 resonate with said integrated coupling transformer at a second frequency in a second frequency band.
2. The integrated center frequency selectable resonant coupling network of claim 1 wherein said integrated coupling transformer further includes a center tap on one of said secondary winding and said primary winding, said center tap facilitating biasing
20 for, respectively, one of said load and said source.

3. The integrated center frequency selectable resonant coupling network of claim
1 wherein said integrated coupling transformer is further arranged to provide an
impedance transformation between said source and said load, thereby improving a
power match between said source and said load.
- 5
4. The integrated center frequency selectable resonant coupling network of claim
1 further arranged to couple a differential signal from said source to said load.
5. The integrated center frequency selectable resonant coupling network of claim
10 1 further including a third integrated capacitive circuit controllably coupled across
said first one of said primary winding and said secondary winding and when so
coupled across said first one of said primary winding and said secondary winding,
effectively in parallel with one of said first integrated capacitive circuit and said
second integrated capacitive circuit, operable to fine tune, respectively, one of said
15 first frequency and said second frequency.

6. The integrated center frequency selectable resonant coupling network of claim
1 wherein said first integrated capacitive circuit and said second integrated capacitive
circuit further include, respectively a first control terminal and a second control
terminal for a first control signal and a second control signal to control coupling of
5 said first integrated capacitive circuit and said second integrated capacitive circuit,
respectively, across said first and said second one of said primary winding and said
secondary winding.

7. The integrated center frequency selectable resonant coupling network of claim
10 1 wherein said first integrated capacitive circuit and said second integrated capacitive
circuit further include, respectively, said integrated switch and corresponding
capacitors and a second switch and corresponding capacitors that are arranged to
present a balanced differential load to a differential signal provided by said source
when one of said first integrated capacitive circuit and said second integrated
15 capacitive circuit is coupled across said first one and said second one of said primary
winding and said secondary winding and when one of said first integrated capacitive
circuit and said second integrated capacitive circuit is not coupled across said first
one and said second one of said primary winding and said secondary winding.

20

20200222 1009933 030702

8. The integrated center frequency selectable resonant coupling network of claim
1 wherein said first integrated capacitive circuit and said second integrated capacitive
circuit each includes, coupled across said first one of said primary winding and said
secondary winding, a series circuit that includes a first capacitor in series with one of
5 said integrated switch that is further in series with a second capacitor, said first
capacitor and said second capacitor arranged to be of equal value.

9. The integrated center frequency selectable resonant coupling network of claim
8 further including a control terminal operable to open or short said integrated switch.

10

10. The integrated center frequency selectable resonant coupling network of claim
1 arranged for selectively and alternatively coupling, from said source to said load, a
first differential signal centered at a frequency that is less than 1 GHz and a second
differential signal centered at a frequency that is greater than 1.8 GHz.

15

11. A radio frequency (RF) receiver front end integrated circuit (IC) arranged and constructed for receiving signals in a plurality of frequency bands, the IC comprising in combination:

- a low noise amplifier (LNA) for amplifying an input signal within the

5 plurality of frequency bands;

a center frequency selectable resonant coupling network comprising in combination;

an integrated coupling transformer having a primary winding coupled to said LNA and a secondary winding including a fixed capacitor parallel

10 coupled thereto;

a first integrated capacitive circuit controllably coupled, by an integrated switch that is actively biased on and off, across a first one of said primary winding and said secondary winding and when so coupled operable to resonate with said integrated coupling transformer at a first frequency;

15 a second integrated capacitive circuit controllably coupled across a second one of said primary winding and said secondary winding and when so coupled operable to resonate with said integrated coupling transformer at a second frequency and wherein controllably coupling a combination of said first integrated capacitive circuit and said second integrated capacitive circuit

20 will resonate said integrated coupling transformer at a frequency in one of the plurality of frequency bands; and

a radio frequency mixer for down converting an output signal at said secondary winding within either one of said first one of the plurality of frequency bands and a second one of the plurality of frequency bands to a base-band signal.

20200922 22:26:00

12. The RF receiver front end IC of claim 11 wherein said integrated coupling
transformer further includes a center tap on one of said secondary winding and said
5 primary winding, said center tap facilitating biasing for, respectively, one of said
LNA and said radio frequency mixer.

13. The RF receiver front end IC of claim 11 wherein said integrated coupling
transformer is further arranged to provide an impedance transformation between said
10 LNA and said radio frequency mixer, thereby improving a power match.

14. The RF receiver front end IC of claim 11 further arranged to couple a
differential signal from said LNA to said radio frequency mixer.

15 15. The RF receiver front end IC of claim 11 further including a third integrated
capacitive circuit controllably coupled across said first one of said primary winding
and said secondary winding and when so coupled, effectively in parallel with one of
said first integrated capacitive circuit and said second integrated capacitive circuit,
operable to fine tune, respectively, one of said first frequency and said second
20 frequency.

16. The RF receiver front end IC of claim 11 wherein said first integrated capacitive circuit and said second integrated capacitive circuit further include, respectively a first control terminal and a second control terminal for a first control signal and a second control signal to control coupling of said first integrated
- 5 capacitive circuit and said second integrated capacitive circuit across said primary winding.
17. The RF receiver front end IC of claim 11 wherein said first integrated capacitive circuit and said second integrated capacitive circuit further include,
- 10 respectively, said integrated switch and corresponding capacitors and a second switch and corresponding capacitors that are arranged to present a balanced differential load to a differential signal provided by said LNA when one of said first integrated capacitive circuit and said second integrated capacitive circuit is coupled across said first one and said second one of said primary winding and said secondary winding
- 15 and when said one of said first integrated capacitive circuit and said second integrated capacitive circuit is not coupled across said first one and said second one of said primary winding and said secondary winding.

18. The RF receiver front end IC of claim 11 wherein said first integrated capacitive circuit and said second integrated capacitive circuit each includes, coupled across said first one and said second one of said primary winding and said secondary winding, a series circuit that includes a first capacitor in series with one of said
5 integrated switch that is further in series with a second capacitor, said first capacitor and said second capacitor arranged to be of equal value.

19. The RF receiver front end IC of claim 18 further including a control terminal operable to open or short said integrated switch.

10

20. The RF receiver front end IC of claim 11 arranged for selectively and alternatively coupling, from said LNA to said radio frequency mixer, a first differential signal centered at a frequency that is less than 1 GHz and a second differential signal centered at a frequency that is greater than 1.8 GHz.

15

21. The RF receiver front end IC of claim 11 wherein said LNA further includes a plurality of narrow band LNAs each for amplifying one of a plurality of signals, each, respectively, within one of the plurality of frequency bands.

20 22. The RF receiver front end IC of claim 11 wherein said radio frequency mixer is a broadband double balanced direct conversion mixer.

20200507 22626001

23. A method in an integrated circuit for processing signals in a plurality of frequency bands, the method including the steps of:

providing an input signal within alternatively a first frequency band and a second frequency band;

5 coupling said input signal to a primary winding of an integrated coupling transformer;

controlling, using an integrated switch that is actively biased on and off, an integrated switched capacitor network that is coupled to said transformer to provide a coupling network that is alternatively and respectively resonant with said integrated

10 coupling transformer at a first frequency within said first frequency band and a second frequency within said second frequency band to selectively provide an output signal at a secondary winding including a fixed capacitor, parallel coupled thereto, of said transformer; and

down converting said output signal.

15

24. The method of claim 23 wherein said step of providing further includes providing a differential input signal and said step of controlling further includes controlling an integrated switched capacitor network that presents a balanced load to said differential input signal within said first frequency band and within said second

20 frequency band.

25. The method of claim 24 wherein said step of controlling further includes controlling an integrated switched capacitor network that includes a series circuit including a first fixed capacitor coupled to a controllable integrated switch coupled to a second fixed capacitor that is arranged to be equal to said first fixed capacitor, said
- 5 series circuit coupled across one of said primary winding and said secondary winding, wherein controlling said controllable integrated switch to be one of a high impedance circuit and a low impedance circuit is included in causing said coupling network to be alternatively resonant at said first frequency and said second frequency.

10